IN FLIGHT TRANSFER OF PACKAGES BETWEEN AERIAL DRONES

BACKGROUND

The present invention relates generally to a system and method for transferring packages and, more specifically, to a system and method for transferring packages between autonomous drones or unmanned aerial vehicles during flight.

Autonomous drones, also referred to as unmanned aerial vehicles (UAVs) and remotely piloted aircraft (RPA), are expected to be ruled eligible for use by private and corporate entities subject to pending to regulations implemented by various aviation authorities such as, for example, the Federal Aviation Admiration (FAA). Proposed uses for drones include, but are not limited to, city ordinance enforcement, other government functions, package delivery, and image capturing. Therefore, it is envisioned that users could purchase drones to achieve a certain set of needs or tasks such as delivering a payload from a warehouse to a customer.

SUMMARY

Embodiments include a system for transferring a payload from an originating drone to a receiving drone. The system includes a first aerial drone having a first transfer member and a first controller, the first transfer member having a first coupling device on one end, the first transfer member being configured to carry a payload, the first controller including a processor configured to change a first altitude and first orientation of the first aerial drone. A second aerial drone has a second transfer member and a second controller, the second transfer member having a second coupling device on one end, the second transfer member being configured to receive the payload, the second controller including a processor configured to change a second altitude and a second orientation of the second aerial drone. Wherein the first controller and the second controller cooperate to change at least one of the first altitude, the second altitude, the first orientation and the second orientation to operably engage the first coupling device to the second coupling device for transferring the payload from the first transfer member to the second transfer member while the first aerial drone and second drone are in-flight.

Further embodiments include an aerial drone. The aerial drone having a fuselage and a plurality of thrust producing devices coupled to the fuselage. A transfer member is coupled to the fuselage, the transfer member configured to move a payload to a second aerial drone. A controller is operably coupled to the plurality of thrust producing devices, the controller including a processor that is responsive to executable computer instructions to adjust the plurality of thrust producing devices to change at least one of an orientation and altitude of the transfer member to move the payload to the second aerial drone.

Still further embodiments include a method of in-flight transferring of a payload between aerial drones. The method includes providing a first aerial drone having a first transfer member. A second aerial drone is provided having a second transfer member. At least one of an altitude and an orientation is changed for at least one of the first aerial drone and the second aerial drone to position the first transfer member adjacent the second transfer member. The payload is moved from the first aerial drone to the second aerial drone.

Additional features are realized through the techniques of the present invention. Other embodiments and aspects of the invention are described in detail herein and are considered a part of the claimed invention. For a better understanding of the invention with the features, refer to the description and to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The forgoing and other features of embodiments of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** depicts a block diagram of an autonomous drone in accordance with an embodiment of this disclosure;

FIG. **2** depicts a block diagram of a controller for an autonomous drone in accordance with an embodiment of this disclosure;

FIG. **3** depicts a perspective view of a package delivery system using an autonomous drone in accordance with an embodiment of this disclosure;

FIG. **4**, FIG. **5**, FIG. **6**, and FIG. **7** depict an in-flight payload transfer sequence between a pair of autonomous drones in accordance with an embodiment of this disclosure;

FIG. **8** depicts an autonomous drone having a dynamic counterbalancing system in accordance with an embodiment of this disclosure;

FIG. **9** depicts an autonomous drone having another dynamic counterbalancing system in accordance with an embodiment of this disclosure;

FIG. **10** depicts an in-flight package transfer of a payload between a pair of autonomous drones in accordance with an embodiment of this disclosure;

FIG. **11** depicts a transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **12**A, FIG. **12**B and FIG. **12**C depict a transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **13**A and FIG. **13**B depict a transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **14**A, FIG. **14**B, FIG. **14**C and FIG. **14**D depict a transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **15**A, FIG. **15**B, FIG. **15**C and FIG. **15**D depict a transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **16** depicts another transfer member coupling arrangement for use with a pair of autonomous drones in accordance with an embodiment of the invention;

FIG. **17** depicts an in-flight transfer of a payload between a pair of autonomous drones in accordance with an embodiment of this disclosure;

FIG. **18**A, FIG. **18**B, FIG. **18**C and FIG. **18**D depict an in-flight sequence of the transfer of a payload between the pair of autonomous drones of FIG. **17**;

FIG. **19**A, FIG. **19**B, FIG. **19**C and FIG. **19**D depict an in-flight sequence for securing the payload transferred between the pair of autonomous drones of FIG. **17**;

FIG. **20** depicts a pair of autonomous drones having tilting rotors in accordance with some embodiments of this disclosure;